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THE FIVE YEAR REPORT OF THE MATERNAL AND INFANT CARE PROGRAMS IN MASSACHUSETTS 1980-1984

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APRIL 1986

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THE FIVE YEAR REPORT OF THE MATERNAL AND INFANT CARE PROGRAM IN MASSACHUSETTS, 1980-1984:

Executive Summary

EXECUTIVE SUMMARY

This report analyzes the data received from the Maternal and Infant Care (MIC) Programs, funded by the Division of Family Health Services (DFHS). It covers the period from 1980 through 1984. Annual reports have been issued previously.

The goal of the MIC programs is to ensure that pregnant women have access to quality comprehensive prenatal care. The specific target populations include women 19 years of age and under, those who are poor or without adequate health insurance, and those who are at risk for poor perinatal outcomes.

The major findings for the 5-Year MIC report are summarized below.

1. Description of the MIC Population

The MIC program has put special emphasis on reaching certain groups: adolescents, unmarried women, minorities, and low income women. It appears that the program has been successful in reaching these groups.

- Adolescents (ages 13-19) account for 27% of all MIC deliveries, while only 10% of Massachusetts deliveries were to women in this age group. The number of teens served by MIC programs has increased each year. In 1980, 6% of pregnant teens in Massachusetts received their prenatal care at an MIC site, while in 1984, this increased to 14.5%. More importantly, about 37% of the births to teenagers in the MICs designated service areas received their care at an MIC site.

- Sixty percent of MIC deliveries were to unmarried women compared to 16% in the state. The MIC provided care to 34% of the unmarried women who delivered in their service areas.

- The MIC program has had a significant impact in reaching racial/ethnic minorities. Thirty percent of babies born to mothers of Hispanic origin in Massachusetts were MIC participants; for Asian women the figure was 42%; and for Blacks the figure was 13%. This contrasts sharply with Massachusetts figures, where during the same period 86% of all births were to White women, 6.2% of births were to Black women, 3.2% to Hispanic women and .6% to Asian women.

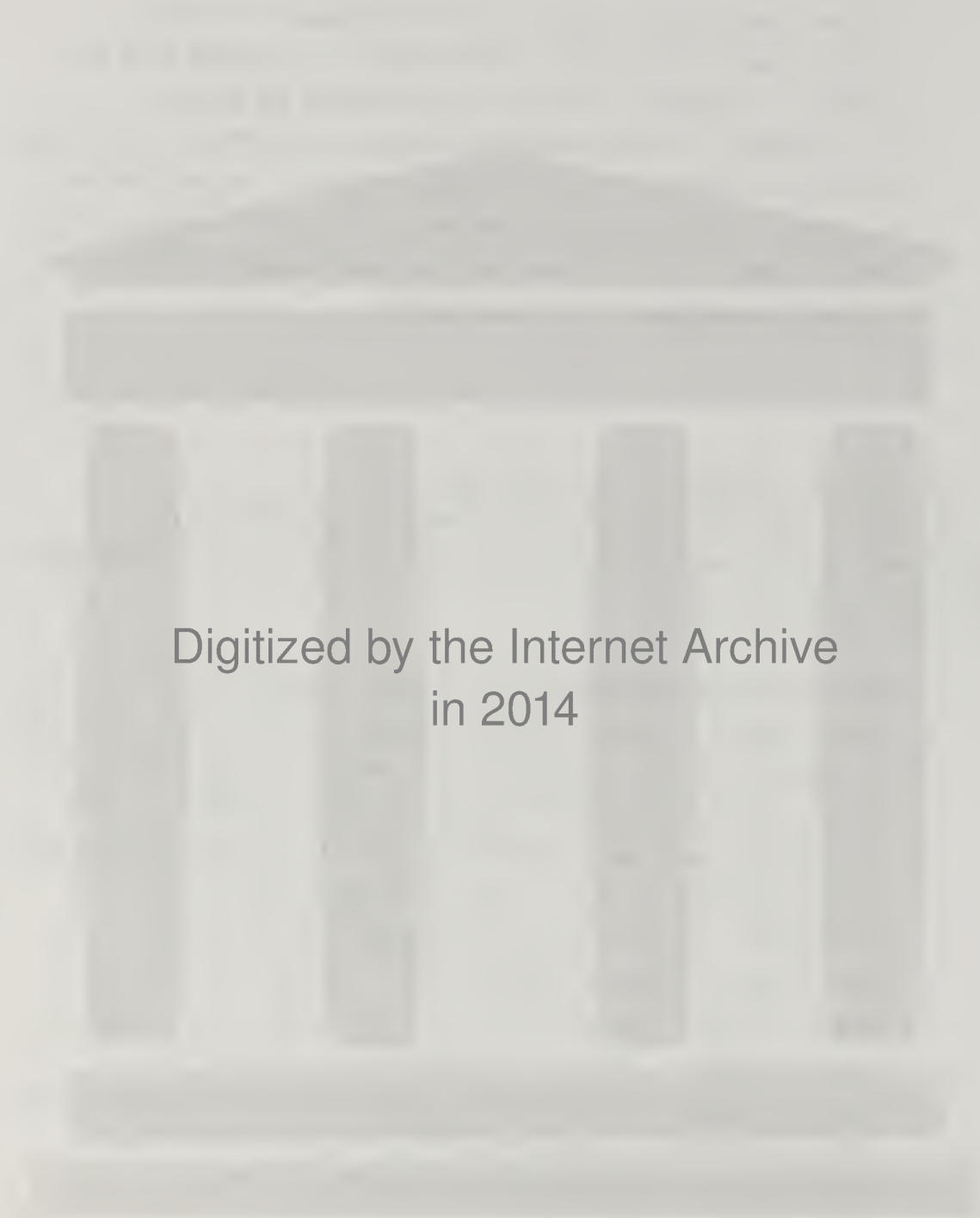
2. Utilization of Prenatal Care Services

The goal of the MIC programs is not only to reach the target populations, but to reach them early in their pregnancy and ensure that they receive adequate care.

- A disturbing trend emerged for prenatal care utilization. The percentage of teenagers having adequate utilization (as defined by when care began, how many visits occurred, and adjusted for gestational age) declined from 37% to 30% from 1980 to 1984. The greatest decline occurred from 1981 to 1982 when there were numerous health and human service cutbacks. This decline paralleled a similar decline in adequate prenatal care utilization for Massachusetts teens. Similar declines were noted for registration in the first trimester for both MIC and state teenagers. The MIC program needs to strengthen the outreach system to bring teenage women into care sooner. There were no declines in adequate utilization or first trimester registration for MIC women older than 19.

3. Analysis of Perinatal Outcome Measures

The MIC data form provides the opportunity to examine risk factors for poor perinatal outcomes in this special population. This information can help to target resources more effectively.



- Adequate prenatal care makes an important difference, even among a high-risk population. Women who had adequate utilization had significantly fewer low birthweight babies compared to women who utilized fewer prenatal services. Women who had inadequate utilization were 37% more likely to deliver a LBW baby compared to women with adequate utilization. Women with intermediate utilization were 18% more likely to deliver a LBW baby compared to women with adequate utilization. Getting women into prenatal care earlier can substantially reduce adverse birth outcomes and reduce health care costs.

- Women who smoked had a greater risk of delivering a low birthweight baby, being transferred to a neonatal intensive care unit, and having a premature baby. The more women smoked the greater the risk. Women who smoked a pack or more per day (heavy smokers) were 50% more likely to deliver a baby of low birthweight than a woman who did not smoke. Women who smoked less than a pack per day (light smokers) were 30% more likely to have a LBW baby compared to non-smokers. Women who were heavy smokers were over two times as likely to have their infants transferred to a neonatal intensive care unit (NICU), compared to non-smokers. Light smokers were 50% more likely to have their infants transferred to a NICU. Heavy smokers were nearly 50% more likely than non-smokers to deliver a premature baby. This is another area where cost-effective measures such as smoking cessation programs are vitally important. The MIC program began a pilot-test program for smoking cessation at two MIC sites in 1985. The results are yet to be assessed.

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SEPTEMBER 1986

ACKNOWLEDGEMENTS

We would like to extend our thanks to Robin Parsons for word processing the report; Diane Olsson for handling all the data coding; and the data processing unit for entering the data on the computer. Special thanks are also due to Bernard Guyer, M.D., M.P.H., Sally Fogerty, M.Ed., Roger Marks, M. Mgmt. and Saul Franklin, M.S. for their reviews and comments on this report.

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I. INTRODUCTION

The primary goal of the Maternal and Infant Care (MIC) program has been to provide comprehensive prenatal care to low income women at risk for poor perinatal outcomes. This objective is attained by funding community health agencies and hospitals that target services to at-risk women residing in their service areas. The MIC program has grown from 11 sites and 2020 MIC-affiliated births in 1980, to 21 sites and 3984 births in 1984. Each year since 1980, demographic, behavioral, obstetric, and perinatal outcome information has been collected for all MIC users. This report examines the data collected from 1980-1984. It is intended to serve the following purposes:

* Describe the sociodemographic characteristics of the MIC population
* Explore whether the target populations are being reached
* Examine the factors influencing utilization of perinatal care services
* Examine the associations between certain sociodemographic and medical variables, and selected birth outcomes
* Explore changes over the five year period in terms of population characteristics, utilization of services and birth outcomes.

II. DESCRIPTION OF THE MIC POPULATION

Since its inception, the MIC program has given special emphasis to certain groups: adolescents, unmarried women, minorities, uninsured women and low income women. Previous research has shown that these groups are more likely to have inadequate prenatal care utilization and be at greater risk for poor perinatal outcomes (1-5). These categorizations, in and of themselves, may not be the source for poor outcomes. For example, minorities, in this case defined as either Blacks, Hispanics or Asians, have often been viewed as being at greater risk for poor perinatal outcomes such as low birthweight and neonatal mortality (6,7). However, race, per se, may not be the risk factor for adverse birth outcomes. It may be a marker for other factors such as lower income, poor housing conditions or less than adequate nutrition. On the average, racial minorities in the United States have lower per capita income than Whites. A consequence of this is less access to health care in general, and prenatal care in particular.(7)

Table 1 compares the percent of the MIC populations in these high-risk groups with the percent in their designated service areas, as well as the state as a whole. In examining the table, it is important to keep in mind that the four groups are not mutually exclusive, i.e., significant numbers of teenage mothers are also single. Therefore, one person could conceivably be counted in more than one group.

TABLE 1

NUMBER AND PERCENT OF DELIVERIES BY SELECTED SOCIODEMOGRAPHIC FACTORS FOR MIC, MIC CATCHMENT AREAS, AND MASSACHUSETTS POPULATIONS 1980- 1984

	MIC		MIC SERVICE AREAS		STATE	
	number	percent	number	percent	number	percent
MATERNAL AGE						
<20	3418	27.2	9320	14.5	36411	9.7
20-34	8460	67.2	51228	79.5	314239	83.5
34+	706	5.6	3906	6.1	25757	6.8
MARITAL STATUS						
Married	4882	39.7	42838	66.5	312902	83.4
Unmarried	7414	60.3	21572	33.5	62154	16.6
ETHNICITY/RACE*						
Black	2516	24.1	15919	24.7	23368	6.2
Hispanic	3006	28.7	6370	9.9	12051	3.2
White	3721	35.6	37330	57.9	324952	86.5
Asian	795	7.6	1001	1.6	2333	.6
Other	423	4.0	3836	5.9	12725	3.4
EDUCATION						
<12	6043	55.4	16370	25.4	58767	15.7
12	3836	35.1	25055	38.9	144019	38.3
≥13	1024	9.4	19384	30.1	161390	43.0

Examination of Table 1 reveals that the demographics of these three populations are markedly different from each other. Comparing the MIC population to all deliveries in the state, it is apparent that the MIC program is serving the designated high-risk groups. Teenagers accounted for 27% of all MIC deliveries, while only 10% of Massachusetts deliveries were to women in this age group. In 1980, the percent of teens in the state receiving prenatal care at an MIC site was 6.1%. By 1984, the figure was 14.5%.

Table 1 also depicts the different configurations for marital status between the two populations. In the MIC program, 60% of women were unmarried at delivery, compared to 16% in the state. In 1980, only 9% of all unmarried women that delivered were MIC-affiliated. By 1984, over 17% of the women in this group received their prenatal care from an MIC program.

Perhaps one of the most significant impacts made by the MIC program is in the area of providing prenatal services to racial/ethnic minorities. From 1981-1984 (reliable information on race was not available for 1980), 30% of babies born to mothers of Hispanic origin in Massachusetts were born to MIC participants; for Blacks, the figure was 13%; and for Asian women, the figure was almost 42%. During the same period, 86% of all births in Massachusetts were to White women; 6.2% to Black women; 3.2% to Hispanic women; and .6% to Asian women.

MIC SERVICE AREAS

As depicted in Table 1, the targeted MIC service areas have higher percentages of deliveries to women in the high-risk categories than the state as a whole. Comparison of the MIC data with their service areas may provide a better indication of the MIC's effect. The service area for each MIC site indicates the pool of potential MIC users. The MIC's 'market share' of their service area is defined as the proportion of deliveries to women residing in a designated MIC service area. It is calculated by dividing the number of potential MIC users by the number of actual MIC users. For example, an MIC program provided services to 55 women and there were 215 women who delivered in that program's service area. The program attracted 55 of the 215 high-risk women or 39% of the potential users.

Where service areas are clearly defined and geographically distinct from other programs, the data provide a fairly accurate description of the MIC programs' share of the 'market'. However, in those situations where service areas are contiguous, overlap or are equidistant for users, the analysis may not be an adequate measure of market share. For example, within the city of Boston, a user may prefer one health center over another regardless of where she resides. A reputation for bilingual staff and cultural sensitivity may draw users from beyond the agency's service area. In some cases, Lawrence for example, the entire city is designated as the service area. In reality, MIC patients are only drawn from specific pockets within the city. In this case, the MIC program's share of the 'market' is under-reported because many Lawrence residents are not potential MIC users.

Using the data from Table 1, about 37% of the teenagers giving birth in designated service areas received prenatal care at an MIC site (3418/9320). For unmarried women, the figure was 34%. Twenty-five percent of births to minorities were MIC-affiliated and 37% of women without a high school diploma received care at an MIC Program. In total, about 20% of all births in service areas were MIC-affiliated. These figures are for all MIC sites combined, and do not reflect the variability among individual sites. In addition, these figures are for the five years of data combined. When examined by year, no trend emerges. MIC programs have held a steady share of the births in their service areas over the past five years.

MIC REGISTRANTS WHO LEFT THE PROGRAM BEFORE DELIVERY

It is inevitable that even if a target population is being reached, there will be some attrition. This may be particularly true about the MIC population who may be more mobile and transient than the general population. Women who register with an MIC program but do not continue to term may do so for reasons such as miscarriage, terminated pregnancy, or a decision to use providers not affiliated with an MIC program. An important concern in this regard is whether there are any groups more likely to leave the program, especially the high-risk groups: teenagers, minorities, unmarried women, and low income women.

Over the past five year period, 1,333 women registered at an MIC program but did not continue through delivery. This represents only 9.6% of the total number of women registered. In this group, 16% of the women listed miscarriage or terminated pregnancy as the reason for not returning, while 'moved or did not return' was recorded for over 80%. It is often difficult to obtain reliable information on reasons for leaving a program. Therefore, these data should be treated cautiously.

An analysis was conducted comparing the women who did not deliver with MIC women who delivered on the following sociodemographic variables: ethnicity, marital status, education, age at registration, parity, and primary language. The purpose of the analysis was to highlight areas where services may need strengthening. For example, determining that non-English speaking women were more likely to leave an MIC program might be an indication that more bilingual/bicultural services are needed.

The results show that there were no statistically significant differences between 'deliverers' and 'non-deliverers' in regard to marital status, ethnicity, and percent of English-speakers. There were significant differences between the two groups on age at registration (X^2=16.17, p=.001), education (X^2=55.85, p=.0001), and parity (X^2=12.88, p=.005).

Further analysis revealed that significant differences in age at registration were due to the fact that relatively higher percentages of older women (34+) were not returning. This may be due to higher rates of miscarriage. The significant finding for education was the result of differences for women with some college education. This group of women was more likely to not continue with an MIC program. With regards to parity, nulliparous women were more likely to not continue.

These findings taken together suggest that groups more likely to not continue to term with the MIC program probably have more flexibility (nulliparous) and are more aware of their options (higher education, women 34+). The major target groups of the MIC are not more likely to leave the program, compared to women who remain through delivery.

III. UTILIZATION OF PERINATAL CARE SERVICES

Successfully targeting certain segments of the population is only part of the task confronting MIC programs. It is equally important to attract potential participants early in their pregnancies, and ensure that they utilize prenatal care services adequately. Two measures are used to assess the degree to which MIC programs are meeting these challenges: adequacy of prenatal care utilization, and trimester of registration.

ADEQUACY OF PRENATAL CARE UTILIZATION

Adequacy of prenatal care utilization is a function of two related factors: trimester of registration and number of prenatal visits adjusted for gestational age at birth. It is designed as a measure of prenatal care utilization and not of the quality of those services. This variable is generated from data on the MIC forms and the birth certificate.

Table 2 compares the adequacy of prenatal care utilization for the MIC and Massachusetts women. For the five year period, 43% of MIC users had adequate utilization, compared to 79% of all Massachusetts women. About 15% of MIC users, (those women who registered late in the second or third trimester and had relatively few prenatal visits), were defined as having had an inadequate level of utilization. This is in contrast to the Massachusetts population where only 2.4% had inadequate utilization.

The percentages of adequate care utilization for the MIC population may be artificially low. The MIC data form does not indicate whether or not a woman transferred into the program. This could mean that in some instances, care had been received earlier in pregnancy but not documented.

TABLE 2
Percent of Adequacy of Prenatal Care Utilization
For MIC and Non-MIC Massachusetts Women, 1980-1984

	ADEQUATE		INTERMEDIATE		INADEQUATE	
	MIC	STATE	MIC	STATE	MIC	STATE
1980	44.6	79.6	41.6	15.1	13.7	2.1
1981	42.3	80.4	41.1	14.1	16.6	2.0
1982	42.2	79.9	42.9	15.1	14.8	2.2
1983	44.3	78.6	40.7	16.7	15.0	2.7
1984	42.3	79.2	43.4	17.0	14.3	2.8
TOTAL %	43.0	79.1	42.3	15.5	14.7	2.4
TOTAL N	5009	298576	4888	58662	1722	10430

Viewing overall percentages for this variable does not provide the full picture. When the percent of MIC teenagers (ages 13-19) who had adequate utilization was examined, a disturbing trend emerged. The percent of MIC teenagers having adequate utilization declined from 38% in 1980 to 32.5% in 1984. The most precipitous decline occurred from 1981 to 1982, a drop of 5%.

Further, statistical analysis revealed that there were only five chances out of a hundred that this decline was due to chance alone. Any probability value less than or equal to .05 is considered statistically significant. In this instance, the trend for declining percentages of adequate utilization for teenagers was tested and found to be statistically significant.

A number of variables were examined in an attempt to further explain this finding. Teenagers were divided into young teens (ages 13-17) and older teens (ages 18-19). Both groups showed similar rates of decline. Adequacy of utilization for teenagers was divided into racial/ethnic groups of Blacks, Hispanics, and Whites (Asians were not included due to small numbers). The results, as presented in Table 3, show a similar overall decline in all three groups, with Blacks having consistently lower rates than Hispanics and Whites.

TABLE 3

Percent and Number of Teenagers (Aged 13-19) with Adequate Utilization by Race, 1981-1984

	BLACKS		HISPANICS		WHITES	
year	percent	number	percent	number	percent	number
1981	32.3	39	42.6	55	47.0	61
1982	33.1	55	43.1	66	30.8	52
1983	28.4	58	35.7	82	38.2	97
1984	22.2	50	34.3	104	37.6	151

Similar declines were noted by region. The percent of teens having adequate utilization in Springfield declined from 36.8% to 29.3% over the five year period, while in Boston, the decline was slightly less, from 36.3% to 33.9%.

Recognizing that MIC sites may need time to establish a reputation in a community, it was hypothesized that centers which had been in existence since 1980 would not have had the same rates as centers which began in either 1983 or 1984. However, this was not substantiated. For centers which had been in existence since 1980, the percent of teens having adequate utilization declined from 37% in 1980 to 30% in 1984. There was virtually no difference between "older" and "newer" centers in 1983 and 1984.

The increase in the percentage of teenagers with less than adequate utilization was not limited to the MIC population. In the Massachusetts population, the percent of teens with adequate utilization declined from 58% in 1980 to 54% in 1984. Statistically, this decline was also significant. The reasons for this decline are also unclear.

The patterns for women older than 19 are not the same as for teenagers. In the general MIC population, there was no discernable trend for adequate utilization over the five year period, nor was there any pattern for Massachusetts women older than 19.

The MIC data were analyzed further to see which groups within this population were at greater risk for not having adequate utilization. A multiple logistic regression was used for this analysis.

TABLE 4
Variables Significantly Associated with Intermediate or Inadequate Care Utilization in the MIC Population

VARIABLE	p-VALUE
Separated or Divorced Marital Status	.0042
Single Marital Status	.0001
Blacks	.0001
Asians	.0001
Parity	<.0001
13-17 Years Old at Delivery	<.0001
18-19 Years Old at Delivery	<.0001
20-26 Years Old at Delivery	.0001

The overall regression was statistically significant ($p<.0001$). The variables presented in Table 4 were found to be significantly associated with intermediate or inadequate utilization in the MIC population. Level of education, Hispanic ethnicity, women 34 and older, smoking status were not significantly associated with the outcome ($p>.05$). Any p-value less than .05 is considered to be statistically significant, and the smaller the p-value, the stronger the association.

Analysis of the MIC data using another statistical method, the odds ratio, answers the question: what are the chances that a factor or group found to be significantly associated with inadequate utilization will have inadequate utilization compared to another group? This type of analysis may help a program plan the most efficient use of limited resources. For example, analysis of this type can help decide whether to target certain geographic regions or hire more outreach workers for the teen population. (See DEFINITIONS section for further examples and discussion of the odds ratio).

The odds ratios presented below were derived from the logistic regression, for the variables significantly associated with less than adequate utilization, controlling for all other variables. The variables presented are each compared to a reference group. The reference group is usually one in which the risk is not thought to be as large. For example, the odds ratio for separated or divorced marital status is obtained by comparing it to married women. The odds ratio means that separated or divorced women are 24% more likely than married women to have had less than adequate utilization. As another example, women ages 18-19 at delivery, are compared to women 27-33. The odds ratio indicates

that older teens are over twice as likely to receive less than adequate utilization, as women 27-33 years old.

TABLE 5
Odds Ratio for Less than Adequate Utilization in the MIC Population

VARIABLE	REFERENCE GROUP	ODDS RATIO
Separated or Divorced Women	Married Women	1.24
Single Women	Married Women	1.27
Blacks	Whites	1.37
Asians	Whites	1.39
Parity (third child)	Parity (first child)	1.51
Age 13-17 at Delivery	Age 27-33 at Delivery	2.81
Age 18-19 at Delivery	Age 27-33 at Delivery	2.12
Age 20-26 at Delivery	Age 27-33 at Delivery	1.43

The odds ratios confirm and restate the findings of the section on Utilizing Prenatal Care Services in succinct and stronger ways. The problem of reaching teens is emphatically highlighted here. Younger teens (13-17) are almost three times as likely to receive less than adequate care compared to women aged 27-33. Differences among racial groups are also noted, with Blacks and Asians 37 and 39 percent respectively more likely to receive less than adequate utilization of prenatal services compared to Whites.

TRIMESTER OF REGISTRATION

Registration by women for prenatal care early in pregnancy has been one of the most important goals of the MIC program. Early registration of high-risk women increases the opportunity for prevention of pregnancy-related medical problems. It also increases the chances of assuring adequate nutrition and it allows more time for necessary referral to other community resources.

Trends for trimester of registration will be examined only for all the MIC programs collectively. Individual program comparisons are not appropriate since early registration is dependent on the characteristics of the specific population served by each program. Certain programs may attract a higher percentage of more mobile or transient populations who are less likely to be early registrants. For example, for individual MIC programs in 1984, registration in the first trimester ranged from less

than 25% to over 75%. This wide range could be due to a number of factors such as age distribution, mobility and access to transportation. It is noteworthy that all programs outside the public transportation network in Boston had lower percentage of first trimester registration in 1984. In addition, there may have been greater out-reach efforts in the Boston area because of the Healthy Mothers Program.

Comparing the MIC population to the state's child-bearing population reveals large differences between the two groups in terms of trimester of registration. During the five year period, 47.7% of the MIC users registered for care in the first trimester versus 87% of all Massachusetts women. The same factor affecting adequacy of utilization may also lower the percent of first trimester of registration, namely, that the MIC form does not indicate whether or not a woman transferred into the program.

This gap in percent of first-trimester registration can be partially explained by the large proportion of teens (25.9%) that utilize MIC services. Adolescents may deny pregnancy and frequently register late for prenatal care. The higher proportion of non-English speaking women may also account for some of the difference. This group may not be aware of the available services. However, the differences between the MIC and Massachusetts population is not explained even considering these factors. For example, among English-speaking women over 19 years of age in the MIC population, only 51.1% registered in the first trimester versus 87.3% all Massachusetts women.

The gap in first trimester registration between the MIC population and the state in general does not appear to be getting smaller. Table 6 compares the percent of women registering in the first trimester for the MIC and non-MIC Massachusetts population, by year. Both populations experienced about a 2% decline in first trimester registration from 1980-1984.

TABLE 6
Percent of MIC Population and State Population Registering in the First Trimester, 1980-1984

YEAR	MIC	STATE
1980	49.1	88.9
1981	48.2	89.1
1982	46.2	88.0
1983	49.1	85.6
1984	46.6	85.6
1980-1984	47.2	87.3
TOTAL N=	5710	323147

The pattern of decline for first trimester registration among MIC teenagers (aged 13-19) is similar to that noted for adequate utilization. This would be expected because trimester of registration is one of the components comprising the adequacy of utilization variable. The percent of first trimester registrations in this age group declined from 43% in 1980 to 36% in 1984. The most precipitous decline occurred from 1981 to 1982, a drop of 7%. Statistical analysis revealed that there was only a one in one hundred chance that this decline was due to chance alone.

Different variables were examined to see if certain subgroups of the teen population were experiencing greater rates of decline than the overall teen population. The results were similar to those reported for adequacy of utilization. Both younger (ages 13-17) and older (ages 18-19) teens showed similar rates of declines in all groups with Blacks having consistently lower rates than Hispanics and Whites. No difference was found between 'older' centers which began in 1980 and 'newer' centers, which started in either 1983 or 1984.

The decline of teenage first trimester registrants was not limited to the MIC population. In the Massachusetts population, the percent of first trimester teenage registrants declined from 70.3% in 1980 to 65.5% in 1984 (although 1984 was actually an increase from a low of 65% in 1983). Statistically, this decline was also significant.

The patterns for women older than 19 are not exactly the same as for teenagers. In the MIC population, there was no discernable trend over the five year period. Over the same period, there was an overall decline of 3.4% between 1980 and 1984 for Massachusetts women. There was found to be a significant linear decline for Massachusetts women.

In summary, significant downward trends were noted for Massachusetts women, both teenagers and adults, whereas in the MIC population there was a significant decline only among teenagers. The MIC teen population experienced this decline across regions, centers, racial/ethnic groups and ages, with the greatest decline occurring between 1981 and 1982; 7%.

V. ANALYSIS OF PERINATAL OUTCOME MEASURES

The data collected for the MIC program offer a unique opportunity to analyze risk factors for adverse perinatal outcomes, such as low birthweight and prematurity. Relatively few studies have examined MIC population data (6, 8, 9). Most have compared MIC participants to matched groups of non-MIC participants in an effort to evaluate the impact of a MIC program. This report is not designed to be a study, but rather to document areas within the MIC programs which have had a positive impact or which may need strengthening.

The perinatal outcomes analyzed in this section are:

1.	Low Birthweight	a weight at birth of less than five and one-half pounds (2500 grams)
2.	Neonatal Mortality Rate	the number of deaths to infants less than 28 days after birth per 1000 live births.
3.	Premature Births	an infant born at a birthweight less than five and one-half pounds and at less than 37 weeks of pregnancy
4.	Transfer to an Intensive Care Unit	

LOW BIRTHWEIGHT

Low birthweight (birthweight less than 2500 grams) is a useful measure of the quality of prenatal care because it is sensitive to the mother's general state of health during the pregnancy. Poor health habits, such as use of tobacco, or alcohol have been shown to negatively affect birthweight(14). Low birthweight (LBW) is also a reliable indicator of health problems in the newborn. Low birthweight babies have a much greater risk of death than normal birthweight babies. Specifically, two-thirds of infant deaths (deaths within the first year of life) are associated with LBW (10). In addition, LBW babies are more likely to have birth defects, be mentally retarded, and have growth and developmental problems (11). A LBW infant who is premature has a considerably higher risk of death than a full term infant who is small

for gestational age (SGA) (11). Very low birthweight babies (birthweight less than 1500 grams) are at an even greater risk for neonatal mortality. Compared with normal birthweight infants, those with very low birthweight are about 200 times more likely to die in the neonatal period (12). There has been a modest decline in proportion of low birthweight infants from 7.6% in 1971 to 6.8% in 1981 in the United States (14). A slightly greater decline occurred in Massachusetts from 7.1% in 1971 to 5.9% in 1981 (14). The MIC program has set the reduction of LBW incidence as one of its primary goals.

For the five year study period, 1.8% of all MIC infants were below 1500 grams at birth (very low birthweight), and 7.3% were between 1500 and 2499 grams. This compares to 1.0% of non-MIC Massachusetts infants who were of very low birthweight and 4.8% who were between 1500-2499 grams.

However, the following table shows that there has been a steady decline in percent of infants between 1500 and 2499 grams in the MIC population, although not for VLBW infants.

TABLE 7
Percent of Infants (<1500 Grams) and Between (1500-2499 Grams) in the MIC Population
1980-1984

YEAR	(<1500 grams)	(1500-2499 grams)	(≥2500 grams)
1980	2.25%	8.02%	89.72%
1981	1.28%	7.86%	90.85%
1982	1.80%	7.51%	90.68%
1983	1.74%	7.21%	91.05%
1984	1.74%	6.73%	91.50%
1980-1984	1.80%	7.31%	90.89%
TOTAL N=	208	900	11193

The test for a statistically significant downward trend for LBW indicated that the trend approached significance but did not achieve it.

There were no apparent trends when the data were broken down by ethnic/racial groups. When the data were examined by level of utilization, it appeared that LBW was reduced for all three levels (adequate, intermediate, inadequate) from 1980-1984, with the largest proportionate reduction in the inadequate utilization group.

The mean (average) birthweight for MIC deliveries has increased steadily from 3182 grams in 1980 to 3228 grams in 1984. The mean birthweights for selected variables are illustrated in Table 8 below. This table gives the number, percent of LBW infants, and mean

birthweight for different levels of various risk factors. It is important to keep in mind that the table examines the effect of each risk factor individually, but in actuality risk factors are interactive.

TABLE 8
Number, Percent of Low Birthweight Infants, and Mean Birthweights for Selected Variables, 1980-1984

VARIABLE	NUMBER	PERCENT LBW	MEAN BIRTHWEIGHT
MARITAL STATUS			
Married	4882	9.0	3286 grams
Separated	673	12.9	3179 grams*
Divorced	357	12.6	3221 grams
Single	6384	12.2	3154 grams*
MOTHER'S AGE AT DELIVERY			
Age 13-17	1313	12.9	3128 grams
Age 18-19	1896	12.0	3155 grams
Age 20-26	5882	10.3	3214 grams*
Age 27-33	2768	10.7	3261 grams*
Age 34+	516	13.0	3273 grams*
MOTHER'S EDUCATION			
9th grade or less	2944	11.5	3176 grams
10-11th grade	3099	10.9	3179 grams
High School graduate	3836	10.1	3238 grams*
Some college	1024	8.8	3296 grams*
ETHNICITY/RACE (1981-1984 only)			
White	3631	7.3	3291 grams
Black	2482	11.7	3127 grams*
Hispanic	2949	9.1	3194 grams*
Asian	763	7.7	3120 grams*
LEVEL OF SMOKING			
Non-smoker	5322	9.2	3275 grams
Light smoker (<1 pack/day)	2144	12.7	3138 grams*
Heavy smoker (≥1 pack/day)	688	15.3	3079 grams*
TRIMESTER OF REGISTRATION			
First trimester	5710	10.3	3238 grams
Second trimester	4823	11.1	3195 grams*
Third trimester	1441	11.0	3180 grams*
ADEQUACY OF PRENATAL CARE UTILIZATION			
Adequate utilization	5009	9.4	3263 grams
Intermediate utilization	4888	10.8	3197 grams*
Inadequate utilization	1722	12.4	3143 grams*

*there was a statistically significant difference ($p \leq .05$) between the birthweight of the first level of the variable listed and the level marked.

The effect of each of these variables on birthweight, taken individually, is highlighted in Table 8. There was a linear trend relationship for each variable, except marital status, depending upon level of risk. The higher the level of risk, the lower the mean birthweight.

In order to measure the contribution of each factor to low birthweight, it is necessary to look at all factors simultaneously. This was done through computation of a logistic regression. The following variables were analyzed to see which were significantly associated with low birthweight in the MIC population:

Adequacy of prenatal care utilization
Mother's education
Ethnicity/race
Marital status
Smoking
Gestational age
Parity
Gravida
Mother's age at delivery

The overall regression was significant (p=.0001). The variables in Table 9 were found to be significantly associated with low birthweight. Hispanic and Asian ethnicity, and mother's age at delivery were not significantly associated with LBW (p>.05).

TABLE 9
Variables Significantly Associated with Low Birthweight in the MIC Population

VARIABLE	p-VALUE
Intermediate utilization	.0283
Inadequate utilization	.0019
Light smokers	.0023
Heavy smokers	.0027
Gravida	.0006
Parity	.0077
Separated or divorced	.0078
Single	.0001
Blacks	.0001
Education	.0048

Odds ratios were then calculated for all significantly associated variables. The results are given in Table 10.

TABLE 10

Odds Ratio for Variables Significantly Associated with Low Birthweight

VARIABLE	REFERENCE GROUP	ODDS RATIO
Intermediate utilization	Adequate utilization	1.18
Inadequate utilization	Adequate utilization	1.37
Light smokers	Non smokers	1.29
Heavy smokers	Non smokers	1.49
Parity (first child)	Parity (third child)	1.33
Separated or divorced	Married	1.41
Single	Married	1.46
Blacks	Whites	1.39
Education (9th grade)	Education (12th grade)	1.20

Each of the risk factors listed above elevates a MIC woman's risk of having a low birthweight infant anywhere from 18%-49%. For example, a woman who smokes more than a pack of cigarettes a day is about 50% more likely to deliver a low birthweight baby than a woman who does not smoke, regardless of her race, education, marital status or any other factor analyzed.

These findings reinforce other studies on low birthweight. For the MIC population, having adequate prenatal care utilization greatly reduces the risk of a low birthweight baby. The findings that Black women have greater risk of low birthweight children compared with White women supports other studies showing the relationship between sociodemographic variables and birthweight. The difference between Black and White women may be due to a number of factors such as income, housing, or access to care. The relationship between smoking and LBW is also well-known (13).

NEONATAL MORTALITY

The first 28 days of life are defined as the neonatal period. Survival during this period has been used as an index of the quality of health care. Neonatal mortality is generally recognized as a sensitive health status indicator. In the United States and Massachusetts, there has been an overall decline in neonatal mortality since 1950. Advances in medical treatments and improvements in perinatal services may have contributed significantly to this reduction (15).

Any rates calculated for the MIC population should be interpreted with caution. The status of the infant is determined by a voluntary

postpartum check-up around the infant's 28th day of life. About 10% of the MIC population does not return for this visit. A woman whose infant has died may be less likely to report this to the MIC program after delivery and would be counted as an unknown. With this caveat, it is noteworthy that the MIC population's neonatal mortality rate increased from 7.3/1000 live births in 1981 to 9.4/1000 live births in 1982, the same time period that the state's neonatal mortality rate increased from 6.9 to 7.6. These increases coincided with a rise in poverty and with reductions in many health and human service programs. The NMR continued to be elevated for the MIC in 1983 and 1984, where the rate was 9.2 and 10.2 respectively. While for the State, the NMR decreased from 6.3 in 1983 to 6.0 in 1984.

As an indication that neonatal mortality is tied to socioeconomic factors, in Massachusetts, the neonatal mortality rate for Blacks from 1980-1984 was 11.7, while for Whites it was 6.9. In the MIC population, where there is much less disparity of wealth, Blacks have slightly lower neonatal mortality rates (7.95) than Whites (8.87) and Hispanics (9.64).

An analysis of the potential risk factors (listed on page 17) for neonatal mortality in the MIC population revealed only birthweight as a significant predictor with a p-value of <.0001. An MIC infant who weighed 1500 grams was 42 times more likely to die than an infant who weighed 3000 grams.

PREMATURITY

Premature births are one of the most important causes of perinatal death and neonatal morbidity. For purposes of this report prematurity is defined as an infant born at a birthweight less than 2500 grams and at less than 37 weeks gestation. The duration of gestational age is usually measured from the first day of the last menstrual period. Factors such as maternal age, education and smoking have been associated with an elevated risk of prematurity. It is not clear how some socioeconomic factors (e.g., education) are related to prematurity. They may be a marker for other factors not measured, such as nutritional status.

A woman who delivers prematurely is at much greater risk for having a low birthweight infant. In the MIC population, 57% of infants less than

37 weeks were LBW, while only 6% of normal gestational age infants were LBW. An analysis was conducted to see which variables were significantly associated with prematurity in the MIC population. The analysis found that the following variables were statistically significant: separated or divorced marital status, single women, heavy smokers, parity (birth of first child versus birth of third child), and mother's age at delivery (ages 13-17 and 18-19 versus ages 27-33), again, using gestational age as a control variable.

Odds ratios were completed for these variables and the results are presented below.

TABLE 11
Odds Ratios for Variables Significantly Associated with Prematurity

VARIABLE	REFERENCE GROUP	ODDS RATIO
Separated or Divorced	Married	1.68
Single	Married	1.55
Heavy Smokers	Non-smokers	1.48
Parity (first child)	Parity (third child)	1.30
Mother's age (13-17 years)	Mother's age (27-33 years)	1.48
Mother's age (18-19 years)	Mother's age (27-33 years)	1.61

TRANSFER TO AN INTENSIVE CARE UNIT

The MIC data form records whether the infant was transferred to a neonatal care unit. The transfer could be either intra- or inter-hospital. There are a number of reasons why a baby would be transferred to a neonatal intensive care unit (NICU), including complications related to birthweight, respiratory problems or congenital anomalies. The transfer of a baby to a NICU can cause an enormous strain on the family, both emotionally and financially. Where the mother lives may also add to the stress of the situation. For example, a woman living in Athol would have to travel to Worcester or Springfield . Transfer to a NICU also adds substantially to the costs of health care.

The MIC data form does not include the reasons why an infant would be transferred to a NICU, only whether the infant was transferred. Therefore, it is only possible to examine the groups at highest risk for being transferred. Over the study period, about 7% of MIC infants were transferred. Almost 79% of MIC infants with very low birthweight (<1500 grams) were transferred. About 24% of MIC infants with birthweight

between 1500 and 2499 grams went to a NICU. About 4% of infants with birthweights greater than or equal to 2500 grams were transferred. It appears that there were differences in transfer patterns among ethnic/racial groups in the MIC population. A higher percentage of Hispanic infants than other groups were transferred to a NICU. This difference seems to hold true for infants of both normal and low birthweight. Table 12 following shows the percent of infants transferred to a NICU by ethnicity/race for both low and normal birthweight infants.

TABLE 12
Percent of Low and Normal Birthweight Infants Transferred
To An Intensive Care Unit by Ethnicity/Race, 1980-1984

	<2500 grams		≥2500 grams	
	number	percent	number	percent
Blacks	80	29.7%	44	2.4%
Hispanics	95	34.9%	112	5.1%
Whites	90	30.9%	117	4.0%
Asians	16	18.9%	6	.9%

A logistic regression was computed to identify potential risk factors for transferring to a NICU. The overall regression was significant ($p=.001$). The variables listed in Table 13 (with accompanying p-values) were found to be significantly associated with receiving care in a NICU. Blacks, marital status, education, gravida and adequacy of utilization were not significantly associated with being sent to a NICU ($p>.05$).

TABLE 13
Variables Significantly Associated with Transfer
To A NICU in the MIC Population

VARIABLE	p-VALUE
Birthweight	<.0001
Hispanics	.0001
Heavy Smokers	.0001
Light Smokers	.0016
Age at Delivery	.0004
Parity	.0019
Asians	.0460

Odds ratios were then calculated for these variables. A birthweight of 1500 grams was compared to a birthweight of 3000 grams. Because low birthweight is such a large factor in transfers to a NICU, it is

important to keep in mind that the odds ratios for the other variables are significant even after controlling for birthweight, as well as gestational age.

TABLE 14
Odds Ratios for Variables Significantly Associated with Transference to a NICU in the MIC Population

Birthweight (1500 grams)	Birthweight (3000 grams)	9.78
Hispanics	Whites	1.93
Asians	Whites	.67
Heavy Smokers (≥1 pack/day)	Non-Smokers	2.16
Light Smokers (<1 pack/day)	Non-Smokers	1.46
Parity (first child)	Parity (third child)	1.32

A number of findings result from this analysis. Hispanic infants are almost twice as likely as White infants to be in a NICU. Asian infants are one-third less likely than Whites to be in a NICU.

There appears to be a dose-response relationship between smoking and transfer to a NICU, with non-smokers having the lowest risk and heaviest smokers having the greatest risk. This finding may be one more indication of the economic impact of smoking on the health care system. An odds ratio for mother's age at delivery was not calculated because a curvilinear relationship exists between mother's age and transfer to a NICU. The highest percentages are in younger teens and women over 34.

women gain access to jobs, they will continue to exist at a level of poverty which does not support a healthy existence for themselves or their children.

Increasingly evident in this report is the need to develop smoking cessation programs specifically targeted for women at MIC programs. The statistical relationship of smoking to low birthweight, neonatal intensive care unit admissions and prematurity emphasizes the association of smoking with negative outcomes. A smoking cessation program which is sensitive to the stresses of low income women and which is ethnically and culturally appropriate needs to be implemented. The Maternal and Child Health Section of the Department of Public Health is currently working on materials for use at MIC programs and will evaluate them. If successful, the implementation of smoking cessation programs will be a high priority during its next funding cycle.

The five year report is an opportunity to look at the strengths and weaknesses in the MIC program and how the program has changed over time. It provides documentation that the MIC program is truly serving the target population and has been most effective in increasing positive birth outcomes for a high-risk population over time. For example, the percent of infants weighing 1500-2499 grams at birth in the MIC population has declined each year from 1980-1984. The report also challenges the MIC program to develop strategies for insuring early registration and continuous prenatal care for the very neediest groups within the population served. It identifies areas where MIC programs can further reduce low birthweight and neonatal mortality, through effective outreach and follow-up and by implementing smoking cessation activities.

V. CONCLUSIONS AND RECOMMENDATIONS

Analysis of the MIC data from the past five years has significant implications for future MIC programming. What is immediately apparent is the success of the program in reaching low income, adolescent, and minority women, and women at risk for poor perinatal outcome. However, effort needs to be directed at getting these women into care earlier. The percentages for registration in the first trimester and adequate utilization document that the MIC population accesses care later in pregnancy than the general population. Reasons for this may differ for age groups and/or geographical areas requiring a variety of strategies.

Of particular importance, however, will be the development of strategies to reach minority adolescents, particularly young black women, because they had the lowest rates of adequate utilization. Programs which serve teens need to identify ways of getting them to come into care as early in their pregnancies as possible. Because of the complexity of medical, psychological and social problems inherent within this group, early and continuous prenatal care is essential. A statewide media campaign emphasizing early and continuous prenatal care can be tailored to reach those women who seek care later in their pregnancies.

Community-based outreach to women, especially adolescents, may be most effective. Community women who are trained to do outreach and provide support to young, pregnant women can significantly impact early registration. Frequent prenatal visits during the early stages of pregnancy may also help to insure that women will stay in care and that problems will be identified as early as possible.

The sociodemographic profile of the MIC population indicates that a large percentage of women served by MIC programs have limited education. Forty-eight percent of women over 20 served by MIC programs from 1980-1984 lacked a high school degree. As noted in the MIC annual reports, lack of education often indicates a cycle of poverty which is extraordinarily difficult to break. Programs need to develop referral networks to services which encourage and advocate for job training, educational and vocational counseling, and day care. Until many of these

VI. LIMITATIONS

The data that are analyzed in this report were collected from all the MIC sites between January 1, 1980 and December 31, 1984. The results of the analysis and the conclusions should be viewed in the context of the following limitations:

1. Complete information was not available for all the women who delivered. The data form underwent two revisions over the study period, where additional variables were added. For example, there was no information on smoking from 1980-1981.

   Also, occasional data forms had missing information, which limited their usefulness for certain analyses.

2. There were 1333 women who registered at a MIC site, but did not stay with the program through delivery. There are a number of possible reasons for this:
   - Transfer to another MIC facility
   - Transfer to a non-MIC health facility
   - Participants may have moved
   - Pregnancy was terminated or miscarried

3. The data analysis only refers to the MIC population. It would not be appropriate to draw inferences from the MIC program analysis to the general population. The MIC population differs from the general population in important ways, e.g., there are significantly more teenaged mothers and families of lower income in the MIC population , and it is a self-selected population.

4. Each MIC site has a defined service area. For programs outside of Boston, service area data are indicated for the respective town/city. In Boston, census tracts are used to designate service areas. The primary goal for all programs is to serve the high risk population within their service area. A comparison of MIC data with local community data will give an indication of how well programs have reached this goal.

It should be noted, however, that some programs may target a particular at-risk group within their service area, e.g., all Hispanics within the city of Lawrence. Although the Lawrence program may target Hispanics, others are eligible and need the program. In this case, a comparison of MIC data with all residents of Lawrence will not indicate how well this program has served its target population.

Secondly, the service areas for certain programs may overlap or change. This is especially true for programs in Boston and along the North Shore. Therefore, particular programs may not appear to be reaching their target populations, when in fact, the high-risk group may be divided between two adjoining programs.

VII. SELECTED DEFINITIONS

ADEQUACY OF PRENATAL CARE UTILIZATION-

This variable is based on the trimester of registration, the number of prenatal visits and is adjusted for the gestational age (number of weeks at delivery) of the infant.

LOGISTIC REGRESSION -

Logistic regression is a statistical method for analyzing data where the outcome of interest is dichotomous (e.g., 0 or 1, yes or no). For example, to calculate a logistic regression for birthweight, it was divided into two categories (<2500 or $\geq$2500 grams). Birthweight is then called the dependent variable. All the potential risk factors (or independent variables) are then entered into the computer to see which ones are significant predictors of low birthweight.

Logistic regression examines the association of each independent variable with low birthweight while controlling for all other independent variables simultaneously. Controlling for a variable means that its effect is taken into account during the computations.

ODDS RATIO -

The computer output from a logistic regression also provides the basis for calculating a basic measure of association: the odds ratio. This measure, also known as a cross-products ratio, is widely-used in scientific and medical contexts as a measure of association for 2x2 tables.

A hypothetical example of a 2x2 table is given on the following page, comparing smoking to non-smoking mothers for low birthweight.

	BIRTHWEIGHT <2500	≥2500	
	(a)	(b)	
SMOKERS	10	50	60 SMOKERS
	(c)	(d)	
NON-SMOKER	6	60	66 NON-SMOKERS
	16	110	
	LOW BIRTHWEIGHT	NORMAL BIRTHWEIGHT	

The formula for obtaining an odds ratio is $OR = {}^{(a)(d)}/_{(b)(c)}$

The above example would be $OR = {}^{(10)(60)}/_{(6)(50)} = 2.$

The interpretation is that the odds of a woman who smokes delivering a baby of low birthweight are twice as great as for a woman who does not smoke.

PROBABILITY (OR P-) VALUE -

For this report, a significant association is defined as an association whose maximum probability of occurring by chance is less than five times out of 100: $p<.05$. The smaller the probability value ("p"), the less likely that the particular association occurred by chance. For example, a 'p' value of .001, means that there is only one chance in a thousand that an association is due to chance.

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